

Preface: Environmental Science

A critical lesson learned in the past decade is that technology skillfully created to increase industrial production and to advance our standard of living is not an unqualified triumph over nature. We have come to realize that decisions to apply sophisticated technology must involve realistic evaluations of probable consequences in the vast interactive system that is our natural environment.

The environment must be regarded as an enormously complex system, one that includes not only the interdependent oceans, air, and land, but also all forms of life and energy. The environmental problems that are our concern today—air and water pollution, waste disposal, conservation and renewal of natural resources, and lessening of the effects of natural disasters—cross geographic and political boundaries. They have legal and economic implications; they affect human lives; and they are characterized by enormous quantities of data.

Though the problems are of unprecedented scope, new technology and techniques, such as instrumentation for remote sensing, parallel-processor computers, satellites, and managerial sciences and systems analysis, have begun to provide two key elements for sound environmental decision-making: the capacity to manage large amounts of data and the capability of simulating mathematically large complex natural systems.

We cannot expect to attain absolute solutions. But we can seek optimal solutions and implement the best cost-benefit decisions derived from a strategy of compatibility between society and nature. This strategy, which has been called an ecostrategy, depends on scientific knowledge and understanding of physical laws and natural processes; systematic modeling of the environment and the effects of man's activities; and ability to reliably predict future states of the environment based on natural laws and proposed technological changes.

The nine papers on environmental topics in this issue of the *Journal* illustrate some of the IBM activities underway in the context of such an ecostrategy. The environmental models that simulate rainfall (described by Abraham et al.), forest growth (Botkin et al.), ground-based waste disposal (Freeze), soil subsidence (Gambolati), and dispersion of atmospheric pollutants (Shieh et al. and Shir) are based on on-going investigations of the physical laws governing natural phenomena. They suggest the complexity and dynamic nature of problems confronting environmental decision-makers and resource administrators. The data classification paper by Nagy and Tolaba discusses the efficiency of obtaining information from remotely observed data. Peterson and Wahi describe an interactive combination of computing capability with management science techniques in an educational approach to real-time decision-making. Braslau's communication confirms a critical approximation used in modeling radiation absorption by water vapor and carbon dioxide in the atmosphere.

Collectively these papers indicate how the rapidly increasing quantity and availability of data are providing first-time opportunities to study the systems aspects of the environment through simulation and mathematical modeling. Further development of these techniques should significantly enhance our ability to make viable management decisions on actions affecting our ecosystem.

The Editor